

Title: Robot School Functions**Brief Overview:**

Do you know that there is a Robot Repair School to fix flawed functions? Well, this unit will introduce and allow students the ability to investigate the concept of function tables and become certified graduates of RRS (Robot Repair School). Students learn the crucial parts of a function table (input, output, and rule) and how each intertwines to form a mathematical relationship. The students apply their knowledge of addition and subtraction in order to accurately solve a function table, which is a pre-algebra skill. Upon entering Robot Repair School and graduating at the end of this unit, students will have been exposed to various types of function tables.

NCTM Content Standard:

Standard 1.0 Knowledge of Algebra, Patterns, and Functions

Topic A.

Indicator 1. Identify, describe, extend, and create numeric patterns.

Objective c: Recognize a function table as a relationship between numbers.

Objective d: Complete a function table with a given one- operation rule, (+, -) using whole numbers.

Grade/Level:

Grade 2

Duration/Length:

Three consecutive class sessions, approximately 60 minutes in length

Student Outcomes:

Students will:

- Use function tables to determine the output when given the input using an addition or subtraction rule.
- Use function tables to determine the input when given the output using an addition or subtraction rule.
- Use function tables to determine the addition or subtraction rule when given the input and output.

Materials and Resources:

Preassessment

- Student Resources:

- *Robot Repair School Entrance Exam*(one per student)

Day 1

- Teacher Resources:
 - *Two of Everything* by Lily Toy Hong (one copy)
 - *Function Machine Directions*
 - *Function Machine* (PREMADE from copy box)
 - Post-it notes
 - Markers
 - *Number Cards*
 - *Vocabulary Cards*
 - *Rosie the Robot: Manipulative Mat*
 - *Robotic Websites*
- Student Resources:
 - *Explore: Rosie the Robot* (one per pair/group)
 - *Rosie the Robot: Manipulative Mat* (one per student)
 - *Rosie the Robot: Function Tables* (one per student)
 - *Number Cards* (one per pair/group- cut apart ahead of time)
 - *Robot Repair Exam Day 1*(one per student)
- Classroom Materials:
 - Manipulatives (ex. Cubes, two-colored counters, beans, etc...)
 - Dry erase markers and erasers
 - Wipe-off sheets/page protectors (two per student)
 - Number Cubes (one per pair/group)
 - Number Cubes – higher numbers (one per pair/group)

Day 2

- Teacher Resources:
 - *Function Machine* (from Day 1)
 - *Number Cards*
 - Post-it notes
 - Marker
 - *Rosie the Robot: Function Tables*
 - *Robotic Websites*
 - *Fill in Robert the Robot's Function Tables* (cut apart ahead of time and put in envelopes)
 - Create function tables out of tape on the floor ahead of time (one per group of students plus a few extra)
- Student Resources:
 - *Robot Missing Parts*(one per pair/group)
 - Paper bag containing 24 small manipulatives (one per pair)
 - A paper bowl (one per pair)
 - *Fill In Robert the Robot's Function Table* (cut apart one copy for each group of students)
 - *Rosie the Robot: Manipulative Mat* (from Day 1-one per student)
 - *Rosie the Robot: Function Tables* (from Day 1- one per student)

- *Renee the Robot Rectangle* (one per pair/group)
- *Robot Repair Exam Day 2*(one per student)
- Classroom Resources:
 - Whiteboards
 - Dry erase markers and erasers
 - Manipulatives (ex. Cubes, two-colored counters, beans, etc...)
 - Masking Tape

Day 3

- Teacher Resources:
 - *Rosie the Robot: Function Tables*
 - *Rosie the Robot: Manipulative Mat*
 - *Robotic Websites*
 - *Robot Mind Match* (cut apart and put in envelopes ahead of time- one per pair/group)
- Student Resources:
 - *Rosie the Robot: Function Tables* (from Day 1- one per student)
 - *Explore: Equations Sorting Activity* (one per pair/group)
 - *Rosie the Robot: Manipulative Mat* (from Day 1-one per student)
 - *Robot Repair Exam Day 3*(one per student)
- Classroom Resources:
 - Two index cards per student
 - Manipulatives (ex. Cubes, two-colored counters, beans, etc...)
 - Dry erase markers and erasers

Assessment Day

- Student Resources:
 - *Robot Repair School Certification Test* (one per student)
 - *Shoeboxes* (one per student)
 - *Function Machine Directions* (one per student)
 - *Graduation Certificate* (one per student)

Development/Procedures

Day 1

Pre-assessment (This is for the unit, and will only be found on the first day.)

- Distribute ***Robot Repair School Entrance Exam*** as the pre-assessment.
- Score to determine mastery of those skills.
- If students haven't mastered skills, reteach as needed before moving on to this unit. An answer key is provided.

Engagement

- Read the story, *Two of Everything*, by Lily Toy Hong to the students. This story has a family that puts objects into a pot and then that object will double.

- Discuss with students as you read aloud what is happening with the magic pot in the story. Use the following discussion starters: “What effect did the pot have on the items that fell into it?”, “Which is the most likely explanation for what is happening in the pot and how do you know?”, “If you were Mr. and Mrs. Haktak, what would you put into the pot and why?”
- Tell students that Mr. and Mrs. Haktak found the pot a long time ago but were way ahead of their time. They wanted everyone to benefit from the idea of a magic pot so they invested in mathematicians that could recreate a safer way. They were the original founders of the Robot School because they were so excited about their magic pot. Over the years, their investment grew into a large school of robots, machines, and inventors. They are now looking for new recruits to repair the robots and machines.
- Tell students that they are going to be spending some time with robots and machines over the next few days. They are going to learn how robots and machines work and see if they have what it takes to become a robot repair girl or boy. By the end of the unit, they will create their own math function robot.

Exploration

- Divide students into small groups and give them a copy of *Explore: Rosie the Robot* or rewrite it on larger chart paper. Students will work together to solve the problem using any strategy that they choose. Make sure manipulatives are available for the students who are at the concrete level. An answer key is provided.

Explanation

- Display your function machine that has been made out of a box (See *Function Machine Directions*). Introduce your function machine as Rosie the Robot. Inside your function machine, you will need *Number Cards* or a marker and a pad of Post-It notes. Go over the story problem that students just solved in their exploration groups. On a Post-It, write “+5” and put on your function machine where the rule goes.
- Using *Number Cards* and your function machine, act out the story problem and go over the correct answers.
- Use the following discussion question starters, “What do you notice about how the numbers are changing?”, “What would happen if...”, “How did we get the out number?”
- At this time, explain how a function machine operates and the vocabulary, “in, input, out, output, rule, function”. Post *Vocabulary Cards* for students to see.
- Display *Rosie the Robot: Manipulative Mat* and manipulatives. Write “+3” in the rule box. Put 2 manipulatives in the “IN” box. Model when the 2 manipulatives pass through Rosie the Robot, 3 manipulatives are added, and then you will have 5 in the “OUT” box. Ask students, “How did we come up with the 5 in the out box?”, “What does Rosie do?”
- Distribute manipulatives, *Rosie the Robot: Manipulative Mat* in wipe-off sheets, dry-erase markers, and erasers. Ask students to write “+3” in the rule box. Direct students to put 4 manipulatives in the “IN” box. Together, move the 4

manipulatives through the Rule box, add 3 manipulatives, and then count with the students the end result. Repeat that procedure with students using many different “IN” amounts. Ask students, “Why did you add 3?”, “Explain how you found the output of...”

- Instruct students to erase “+3” and write the rule “+ 4”. Together start with different amounts, move them through the rule box, adding 4 manipulatives each time, and count the end result in the “OUT” box. Ask students to try one on their own so that you can informally assess if students are mastering the skill. Continue asking higher level questions.
- Ask students to erase “+4” and write the rule “-2” in the rule box. Facilitate a discussion as to what the students think will happen now. Use question starters such as “What do you think will happen now? Why?”, “What operation do you see?” Using manipulatives and ***Rosie the Robot: Manipulative Mat***, model what will happen. Start with 10 manipulatives, move them through the rule box, subtracting 2 as you do. Once you slide them into the “OUT” box, count the result. Now ask students to solve one with you. Have students put 8 manipulatives in the “IN” box. Slide them through the rule box, subtracting 2 as they do. Repeat that procedure with students using many different “IN” amounts. Ask students, “Why did you subtract 2?”, “Explain how you found the output of...”, “How is Rosie working?”
- Instruct students to erase the “-2” and write the rule “-3”. Display a copy of ***Rosie the Robot Function Tables*** and explain to students that you are going to write this table showing what we are doing with the manipulatives. Tell them that the function table is keeping track of data that is being generated by Rosie. Together, start with different amounts and move them through the rule box, subtracting 3 manipulatives each time and count the end result in the “OUT” box. Fill in the table as you are working through different starting numbers. Model to students how to write “-3” down the center of the table as you are solving. Ask students to try one on their own (using manipulatives only) so that you can informally assess if students are mastering the skill.
- Collect manipulatives, ***Rosie the Robot: Manipulative Mat***, and hand out copies of ***Rosie the Robot Function Tables*** in wipe-off sheets. Ask students to write the rule “+2” in the rule box of the first table. With students, write the numbers 3, 5, 7, and 9 in the “IN” column. Working together, solve for each “OUT” number. Remind students that they should be writing “+2” in the center as they are working across to find the “OUT” number.
- Invite students to write “-4” in the second function table. Write the numbers 12, 10, 9, and 5 with students in the “IN” column. Solve the function table together remembering to write “-4” between the “IN” and “OUT” column each time. Continue discussion using higher level questions to facilitate math thinking and having students explain how they found their answers.

Extension

- Put students in partner groups.
- Distribute number cubes and one set of ***Number Cards*** to each group of partners. Students are to keep the marker, eraser, and ***Rosie the Robot: Function Table*** in

the wipe-off sheets. Have students work with a partner, but both students will write all numbers on their function tables. One partner will roll the number cube to find the rule and write it at the top of the first function table. Explain to students that they are to make the first function table an adding rule and the second function table a subtraction rule. Partners take turns turning over **Number Cards**, writing that number as the input and solving for the output. Remind students they should be writing the rule next to each input as they are solving. The partner that is not turning over a card is still writing what their partner is doing. Once the first table is complete, it is the other partner's turn to roll the number cube to find the subtraction rule for the next table. Partners again take turns turning over number cards for the input numbers.

- Circulate among students to informally check for understanding.

Differentiation

- Reteach
 - Pull those students who struggled with this lesson and the extension activity as a small group. Give these students manipulatives, **Rosie the Robot: Manipulative Mat**, **Rosie the Robot: Function Tables**, markers, and erasers. Give students rules and input numbers to write on their tables and they will use the manipulatives and their mat to solve each input together with you. As they are solving, they are writing the output number on their table so they are getting more practice with the correlation between the manipulatives and numbers.
- Enrich
 - Provide students with number cubes with higher numbers or 2 number cubes that they could add together. They will find a different partner and use the higher number cube(s) to generate more challenging rules for their tables. They will continue using the number cards for their input numbers.
 - Allow early finishers to use the document **Robotic Websites** to learn more online about function tables and robots.

Evaluation

- Distribute **Robot Repair Exam Day 1** for students to complete independently. This should be collected and checked for mastery of today's objective. An answer key is provided.

Day 2

Engagement

- Remind students that they are in training to become robot repair boys or girls.
- Display your function machine box (Rosie the Robot). Tell students when they came into school today, Rosie was acting differently. Use **number cards** to act out the following scenario. Use a post-it note to write the rule +4. Take the 10

number card and try to put it into the input slot. Pretend that the machine is jammed. Try to put the 10 into the output slot. It will easily go in and out will come a 6 number card. Ask students, “What do you think is going on with Rosie and why?” Hold up the 9 number card and try to put it into the input slot. Pretend that the machine is jammed. Try to put the 9 into the output slot. It will easily go in and out will come a 5 number card. Facilitate a discussion about what is happening and why.

Exploration

- Direct students to find a partner.
- Distribute to each group: a paper bowl, ***Robot Missing Parts***, and a paper bag containing a total of 24 manipulatives.
- Explain rules of the game:
 - Partner 1 will take out any total of manipulatives up to 24 and will record the total on ***Robot Missing Parts*** sheet. Partner 2 closes his eyes while partner 1 hides some of the manipulatives under the bowl. Partner 2 opens his eyes and counts the part he sees and determines how many manipulatives must be hidden in the part under the bowl. Partner 1 then lifts the bowl and they check and record partner 2’s answer. Partners switch roles and continue.

Explanation

- Ask groups to share some of their answers and strategies from the exploration.
- At this time, remind students of the vocabulary they learned yesterday (input, output, rule, function table).
- Distribute white boards, dry-erase markers, erasers, and manipulatives. Display ***Rosie the Robot Function Tables*** and hold up your function machine. Write “+2” in the rule box and a 4 in the first output box. Ask students, “How was Rosie different today?” Tell students “We just reviewed how to solve for a missing number during the exploration. Today we’ll need to use that knowledge to make sure Rosie is working correctly.”
- Explain to students, “When working backwards in a function table, we always use the inverse (opposite) of the rule. So, if the rule is “+2” what operation would we need to use to solve the function?”
- Write the equation “ $4 - 2 = \square$ ”. Ask a student “What is the difference?” Write 2 in the INPUT box. Direct students to check this subtraction with their manipulatives.
- Add several more numbers into the output boxes and model how to solve by using a subtraction equation. Have students record the equations on their white boards and check their answers with the manipulatives.
- Erase your ***Rosie the Robot Function Tables*** and write the rule “-4”. Fill in the following output numbers:

RULE: -4	
IN	OUT
	3

	5
	7

- Remind students, “When working backwards in a function table, we can always use the inverse (opposite) of the rule. So, if the rule is “-4” what operation would we need to use to solve the function?”
- Model writing the equation “ $3 + 4 = \square$ ”. Ask a student “What is the sum?” Write 7 in the INPUT box. Direct students to check this addition with their manipulatives.
- Complete the rest of the chart with student assistance. Students should be writing the equations along with you and checking work with the manipulatives.
- Distribute ***Rosie the Robot Function Tables*** to students. Repeat several addition and subtraction examples with the students having them complete function tables with you.
- Gauge student understanding and repeat using different models as needed.

Extension

- Divide students into groups of 3-4. Ahead of time, create empty function tables on the floor with masking tape. You will need an empty function table for each group of students as well as 2-3 extra.
- Distribute an envelope containing ***Fill in Robert the Robot’s Function Tables*** for each group. Each group will use the cards to complete the function table. Students will lay down the cards into the empty spaces on the floor into the taped function table. Once the group has used the cards to fill in each space they will raise their hand to be checked by the teacher. Once they are correct, direct the group to put their cards back into the envelope and move to a different empty function table. They will leave the envelope with the empty function. The students rotate, not the envelopes.
- Monitor students as they complete the empty function tables.

Differentiation

- Reteach
 - Pull those students who struggled with this lesson and the extension activity as a small group. Give these students manipulatives, ***Rosie the Robot: Manipulative Mat, Rosie the Robot: Function Tables***, markers, and erasers. Give students rules and output numbers to write on their tables and they will use the manipulatives and their mat to solve each output together with you. As they are solving, they are writing the input number on their table so they are getting more practice with the correlation between the manipulatives and numbers.
 - For students who have further difficulty, use dry erase boards to complete missing number problems such as $\square + 8 = 10$, $\square + 3 = 6$, $\square + 4 = 5$. Encourage students to use manipulatives to visually see what is happening.
- Enrich

- Direct students who are ready for enrichment to complete ***Renee the Robot's Rectangle***. Give students an envelope with precut cards. They need to use the cards to create a rectangle by matching the incomplete function table with the missing input. The center piece has Renee the Robot on it.
- Allow early finishers to use the document ***Robotic Websites*** to learn more online about function tables and robots.

Evaluation

- Distribute ***Robot Repair Exam Day 2*** for students to complete independently. This should be collected and checked for mastery of today's objective. An answer key is provided.

Day 3

Engagement

- Remind students that they are in training to become certified to repair robots. Today they will be learning more about robots in order to make sure they know if robots are working correctly.
- Distribute two index cards to each student. Direct them to put a large "+" on one and a large "-" on the other.
- Write on the board the equation " $3 \bigcirc 5 = 8$ " "What is missing?" "What operation would make sense to make this equation true?" Students then hold up their plus sign index card.
- Direct students to use their "+" or "-" index cards to indicate which operation is being used. Repeat with other equations " $4 \bigcirc 1 = 2$ ", " $10 \bigcirc 9 = 1$ ", " $2 \bigcirc 7 = 9$ "
- Continue discussion about why they are choosing each operation.

Exploration

- Group students into partners.
- Direct each group of partners to lay one set of the "+" and "-" index cards on their desk as column headers.
- Distribute ***Explore: Equations Sorting Activity*** (1 to each set of partners). Have students cut apart the equations. Ask them to analyze the number relationships then sort the equations under the appropriate heading. Students should not write on the cards at this time.
- Circulate to monitor student discussions.

Explanation

- Tape column headings onto the board and ask several students to come up and place equations into the correct column.
- Ask students to share their strategies of why they placed their equations into each column.
- Instruct students to complete the missing operation on each card.

- Distribute manipulatives, dry erase markers, erasers, and ***Rosie the Robot: Manipulative mats*** from previous days.
- Ask a student to explain how Rosie the Robot works.
- Review. Use the following question starters “What did the machine do?”, “How is the output affected by the rule?”, “How is the input affected by the rule?”
- Ask students to write “+ 5” in the rule box. Have them put 3 manipulatives in the “In” box. Ask them to complete the function table to find the output. Repeat as necessary if students struggled previously.
- Ask students to write “- 4” in the rule box. Have them put 5 manipulatives in the “out” box. Ask them to complete the function table to find the input. Repeat as necessary if students struggled previously.
- Let the class know that the machine can work in a different ways. Today they will see the INPUT and the OUTPUT but will have to determine the rule.
- Ask students to put 3 manipulatives in the “IN” box and 5 manipulatives in the “OUT” box. Explain to students that there are several ways to figure out the rule. One way is to use comparative subtraction by matching up the manipulatives. After you match up the 3 with the 5, students will see that there are 2 left, which means there is a difference of 2. Discuss where the bigger number is. Right this following equation on the board. $3 \ominus 2 = 5$. “Is the number getting bigger or smaller? How do you know? Since it is getting bigger by 2, what operation do you need?” (+). Have them write the rule “+2” on their mats. Another way to solve is by counting up. Have students put 3 in their heads and count up to 5. “How many do you need to add to get to 5? 2” Another way to solve is by using a number line. Have a student find the 3 on a classroom number line. “How many jumps to get to 5? 2”. Explain to students that we just used three different ways to find the same answer. The rule was “+2”.
- Repeat this procedure several times by using all 3 ways. Use numbers that lend themselves to both addition and subtraction rules. Remember to ask students to explain how they found their answer. Ask students which strategy they prefer to use and why. Have them turn and talk to a neighbor explaining their choice. Students are able to use whichever strategy makes more sense to them.
- Ask students to slide their manipulatives and mat to the corner of their desk. Those students who want to continue using manipulatives can do so.
- Distribute ***Rosie the Robot Function Tables***.
- Model completing the first table. Ask students to fill in their table as follows:

Rule:	
IN	OUT
3	6
4	7
5	8

- Show students how to solve for the rule using the number line and counting up strategies (those students who need manipulatives can use them).

- Use the following question starters to facilitate discussion. “What do you notice about the numbers? Are they getting larger or smaller? How did you determine the rule? What strategy did you use and why?”
- Show students an incomplete function table with a given rule. Remind the students that as robot repair people, they will need to figure out and fix a robot when it is malfunctioning.
- Ask students to write the following information on their ***Rosie the Robot:***

Function Table:

Rule: +5	
IN	OUT
2	
	8
7	

- Model how to complete the function. Ask students, “What is the rule? What are we starting with in the input?” Students should answer. Ask, “What do we need to do to the 2 and why?” Then say to students, “We have the number 8 in the output, how can we find the input?” Complete the next row. For the last row, let students choose any number to put in either the in or the out and complete the table.
- Give additional examples as needed.

Extension

- Explain directions for the partner game ***Robot Mind Match***. Each group of students will receive a set of ***Robot Mind Match*** cards. The goal of the game is to match a rule to a function table with given input and output. Direct them to lay the cards face down on their desks. They will play the game like a typical memory game. Each player will take a turn. On their turn they will flip 2 cards face up. If they come up with a match, they keep the match and it is the next player’s turn. If they do not have a match, turn the cards face down and it is the next player’s turn. Continue play until all the cards have been matched.

Differentiation

- Reteach
 - Place students into a small group the function table concepts to review with manipulatives.
 - If students have difficulty with determining the rule, focus on using the counting up strategy because it is the simplest and most efficient method.
 - If students have difficulty with completing the missing parts of the function table go back to using manipulatives. Practice finding the input and the output in isolation.
- Enrich
 - Divide students who are ready for enrichment into two groups.

- Direct one group to work with a partner to create their own rules and function tables. Switch with your partner and solve each other's table.
- Allow the other group to use the document ***Robotic Websites*** to learn more online about function tables and robots.
- Switch groups.

Evaluation

- Distribute ***Robot Repair Exam Day 3*** for students to complete independently. This should be collected and checked for mastery of today's objective.

Summative Assessment:

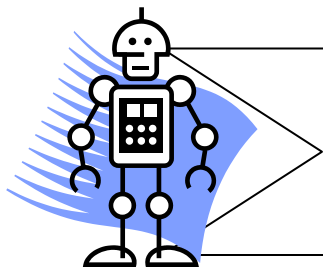
- Students will independently complete ***Robot Repair School Certification Test***. They will apply and demonstrate the skills learned in this unit about function tables. This assessment encompasses all skills taught over the three days. An answer key is provided.
- After completing the summative assessment, students may create their own function machine. Distribute and discuss ***Function Machine Directions*** for students to complete in class or as a supplemental home assignment.
- Distribute ***Graduation Certificate***.

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Robot Repair School

Entrance Exam

Solve the following.

1.) $5+4=$ _____

2.) $6-2=$ _____

Find the missing number.

3.) $7 + \square = 12$

4.) $\square - 5 = 2$

Continue the pattern.

5.) 1, 3, 5, ____, ____, ____

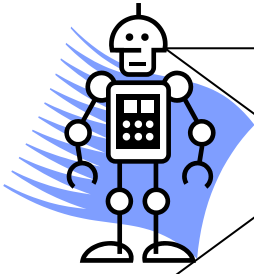
a. Explain how you found your answer.

6.) 2, 5, 8, ____, 14, ____, ____, 23

a. Explain how you found your answer.



Name: _____ Date: _____



Robot Repair School

Entrance Exam

ANSWER KEY

Solve the following.

1.) $5+4=$ 9

2.) $6-2=$ 4

Find the missing number.

3.) $7 +$ 5 $= 12$

4.) 7 $- 5 = 2$



Continue the pattern.

5. 1, 3, 5, **7, 9, 11**

a. Explain how you found your answer.

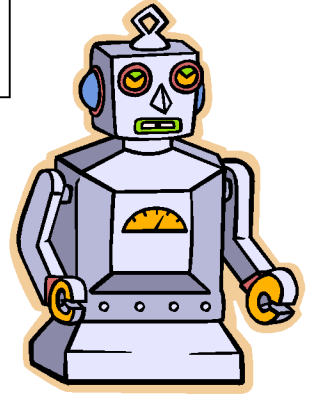
I noticed the numbers given were getting larger. They were counting by 2's and were all odd numbers. So, I skip counted from the 5, up two and found 7. I continued to count on to get 9 and 11.

6. 2, 5, 8, **11**, 14, **17, 20**, 23

b. Explain how you found your answer.

The difference between the numbers 2, 5, and 8 is 3. I tested the 8 to check if the pattern was skip counting by 3, so I added $8+3 = 11$. Then, added $11+3=14$. This pattern of adding 3 each time fits. I continued to skip count by 3 to solve the missing numbers.

EXPLORE: Rosie the Robot



Mrs. Haktak put 2 gold coins into Rosie the Robot and she added 5 coins. A total of 7 came out.

Then Mr. Haktak put 3 gold coins into Rosie the Robot and she added 5 coins. A total of 8 came out.

Then Mr. Haktak put 4 gold coins into Rosie the Robot and she added 5 gold coins. A total of 9 gold coins came out.

With your group, draw, write and talk about what might happen if:

You put in 5 gold coins.	You put in 7 gold coins.
MAKE UP YOUR OWN: You put in ____ gold coins	CHALLENGE: Rosie gave you 15 gold coins.

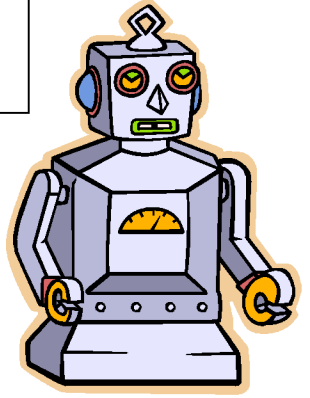


Name: _____

Date: _____

EXPLORE: Rosie the Robot

Answer Key



Mrs. Haktak put 2 gold coins into Rosie the Robot and she added 5 coins. A total of 7 came out.

Then Mr. Haktak put 3 gold coins into Rosie the Robot and she added 5 coins. A total of 8 came out.

Then Mr. Haktak put 4 gold coins into Rosie the Robot and she added 5 gold coins. A total of 9 gold coins came out.

With your group, draw, write and talk about what might happen if:

You put in 5 gold coins.	You put in 7 gold coins.
Rosie will give 10 gold coins.	Rosie will give 12 gold coins.
MAKE UP YOUR OWN: You put in ___ gold coins	CHALLENGE: Rosie gave you 15 gold coins.
Answers will vary.	You put in 10 coins.



Name: _____

Date: _____

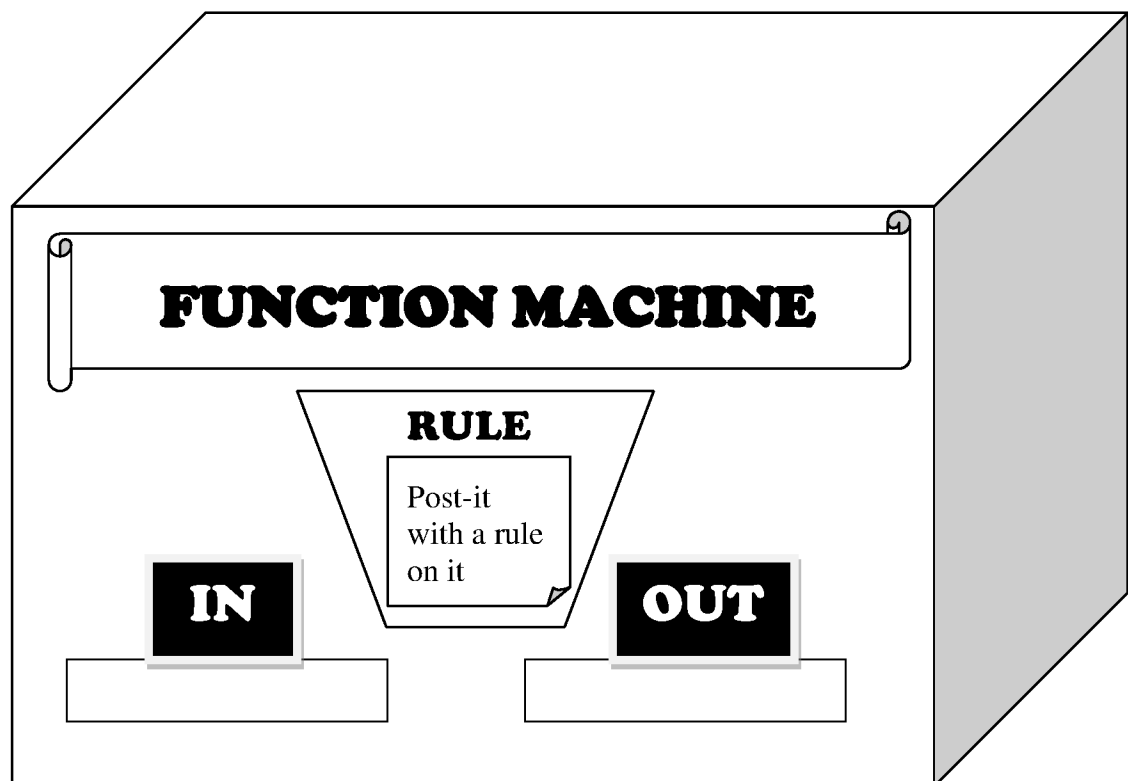
FUNCTION MACHINE DIRECTIONS

Function Machine Creation

1. Find an empty shoe or copy box. On the bottom of the box, cut 2 slits and assemble as shown. Cut out and use the labels below or create your own.
2. Decorate your box to your own theme. Use wrapping paper, foil, yarn, stickers, etc.

Function Machine Usage

1. Write a rule on a post-it and place on the Rule panel.
2. Place box so that the bottom side of box is facing students and the open part is hidden from student view. Inside the box, you will need to have a marker.
3. Use index cards or the included number cards and insert a card into the IN slit.
4. Once the card is inside the box out of student view, teacher applies the rule and writes the correct answer on the back and slides it out of the OUT slot.



FUNCTION MACHINE

RULE

IN

OUT

NUMBER CARDS to cut out

0

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

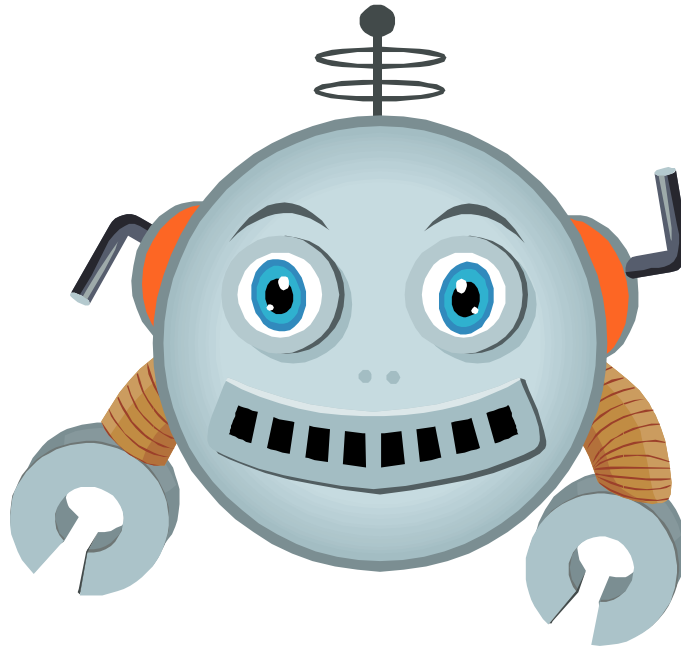
19

20

VOCABULARY CARDS

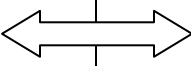
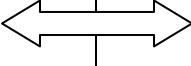
DIRECTIONS FOR THE TEACHER

1. Print out the vocabulary cards (color).
2. Prior to Lesson 1, laminate cards.
3. Use with the first lesson to introduce key vocabulary. Keep posted throughout entire lesson for students to utilize.



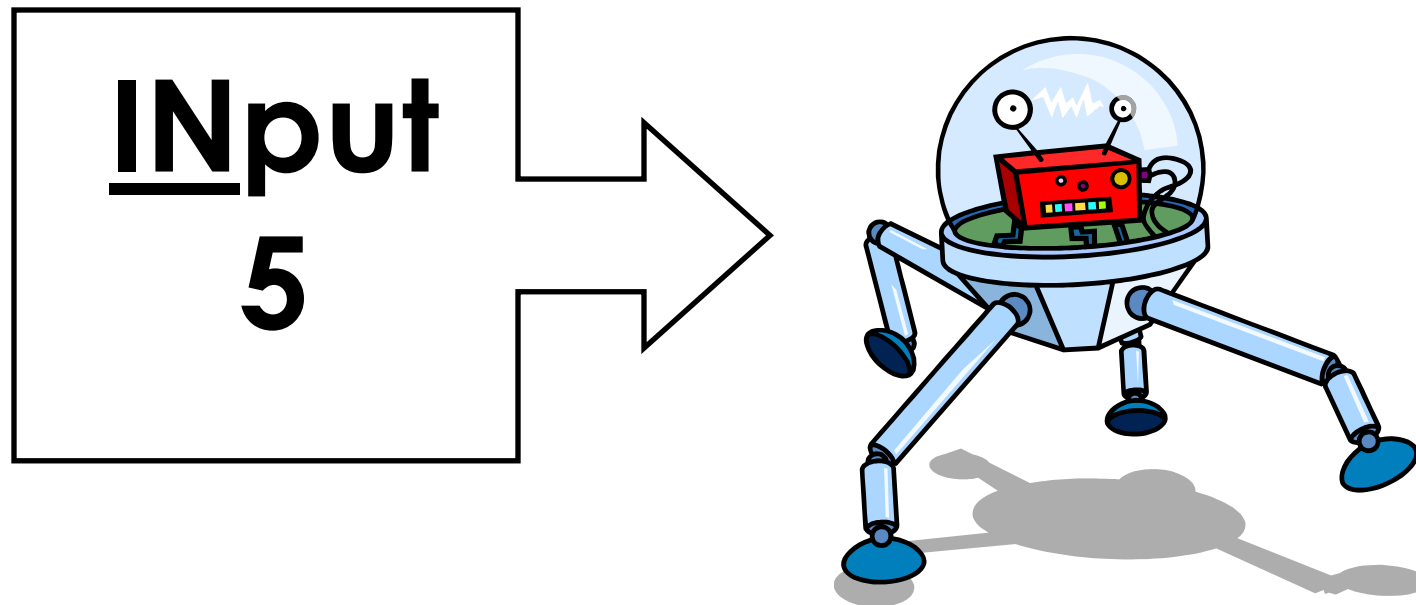
Function Table

A Table that displays a relationship between pairs of numbers based on a rule.

Rule: <u>+ 4</u>		
INPUT		OUTPUT
1		5
2		6

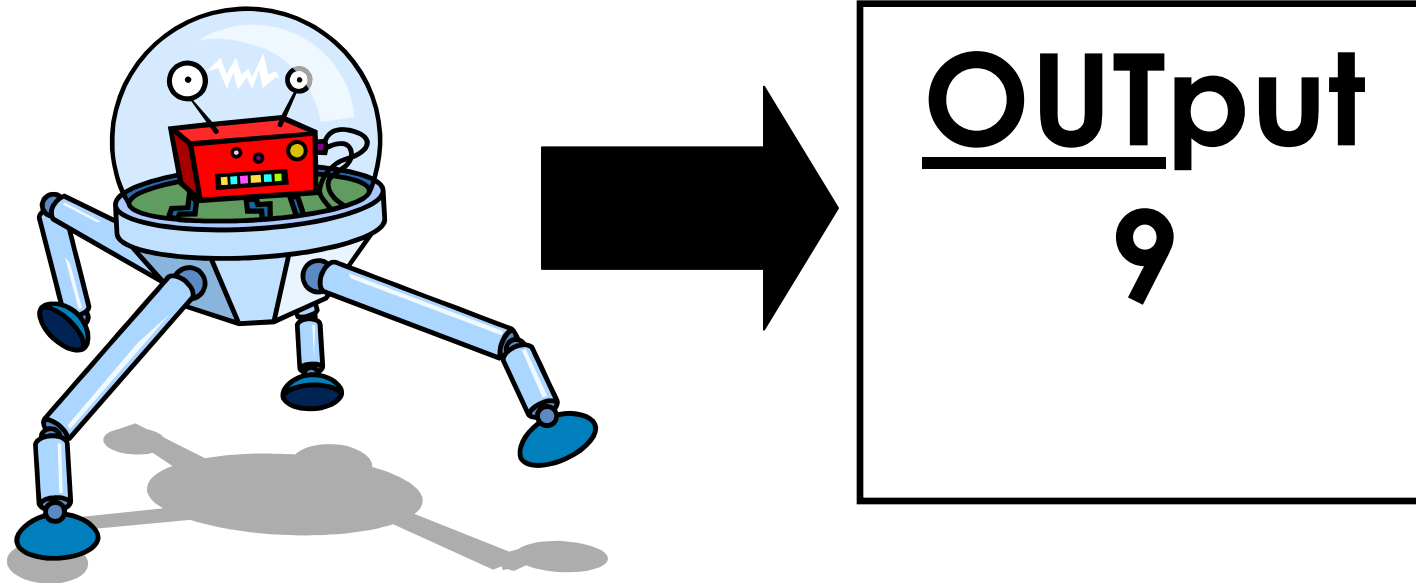
INput

The number that goes IN the robot machine.



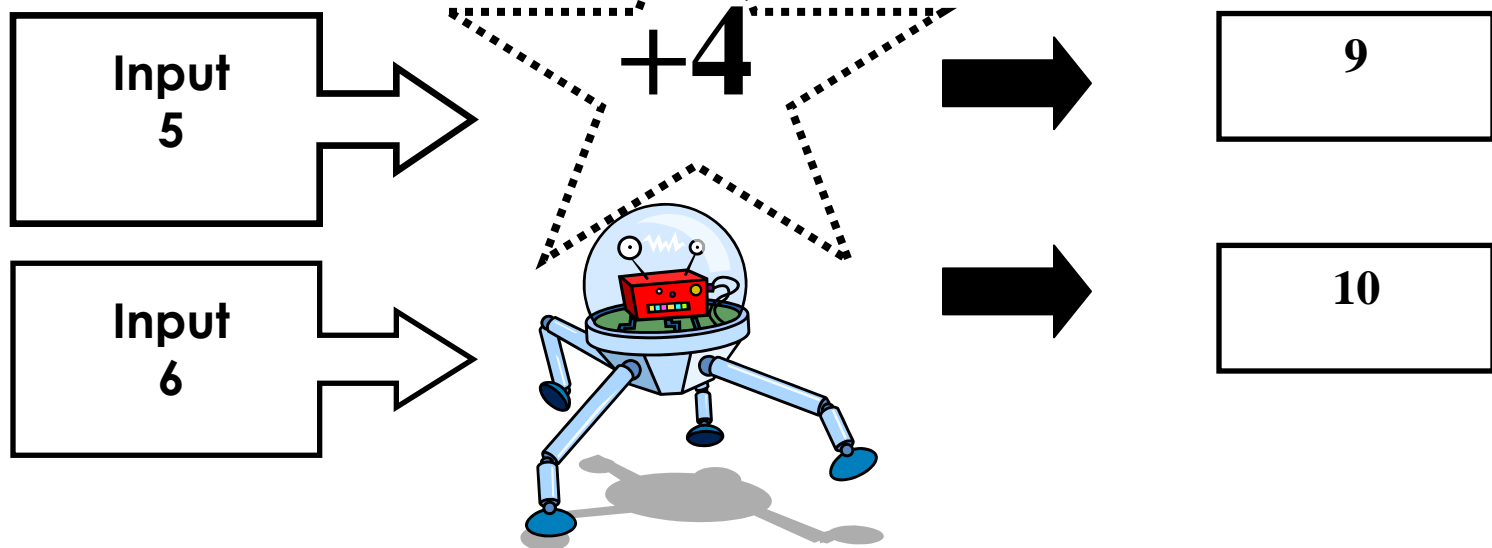
OUTput

The number that comes OUT of the robot machine after rule is applied.

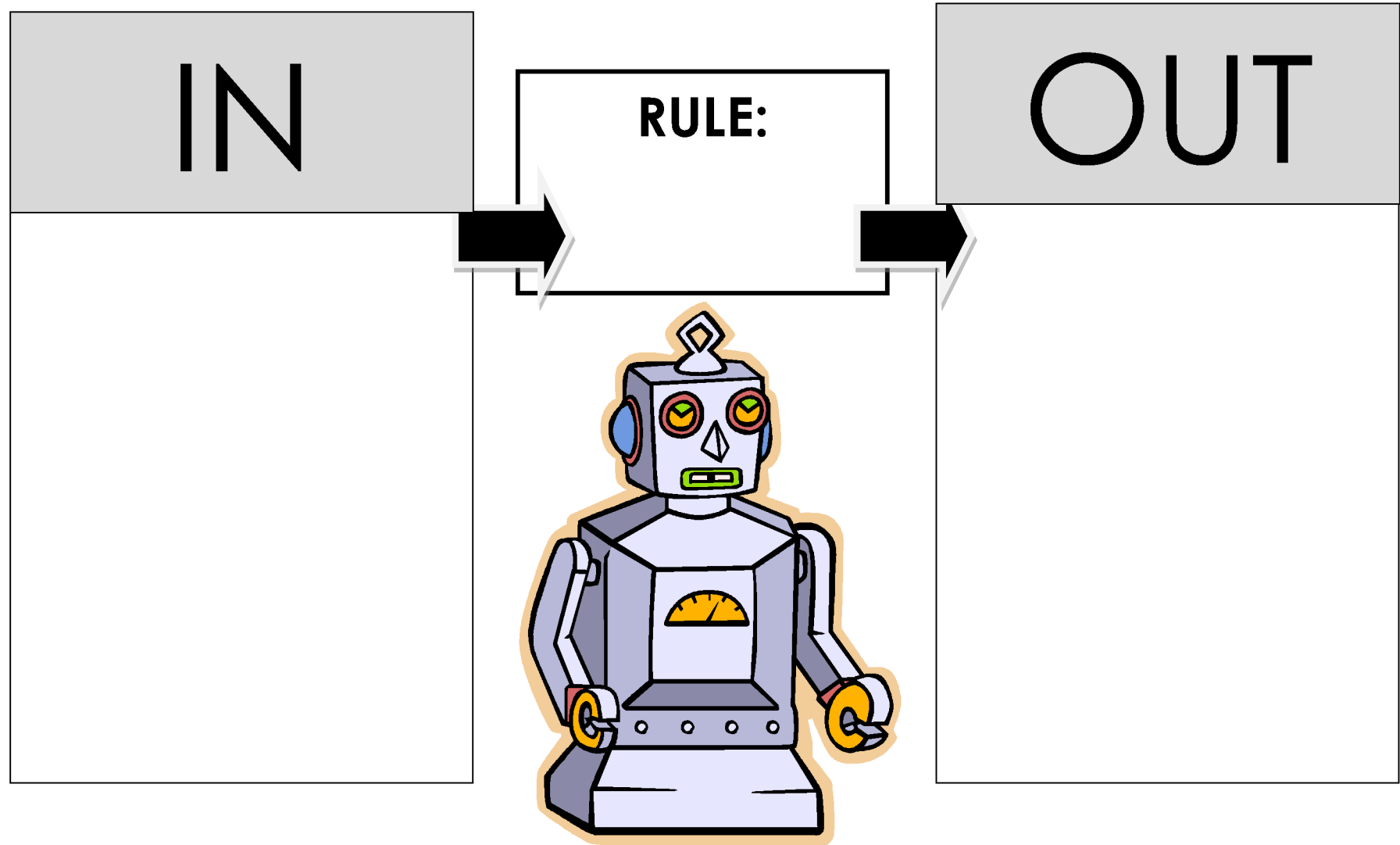


Rule

The operation a function **MUST** follow at all times!



ROSIE the ROBOT: MANIPULATIVE MAT



Rosie the Robot Function Tables

Rule: _____

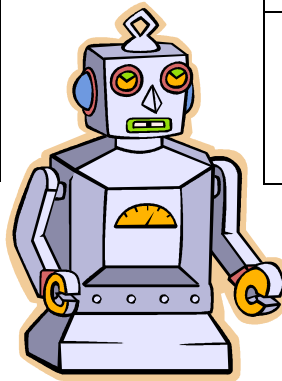
IN

OUT

Rule: _____

IN

OUT



Robotic-Web-Sites

At the same time, hold down the Control (Ctrl) key and click on the blue link.

Interactive Websites

- Interactive Robot Function Table Site

Input/Output Function Machine

http://teams.lacoe.edu/documentation/classrooms/amy/algebra/3-4/activities/functionmachine/functionmachine3_4.html

- Drag, Drop, and Discover

Find the RULE and SOLVE

http://nlvm.usu.edu/en/nav/frames_asid_191_g_3_t_1.html

- Stop That Creature!

Find the Rule...X out a clone

<http://pbskids.org/cyberchase/games/functions/>

- ☆Challenge: Math Playground

What's the Function?

<http://www.mathplayground.com/functionmachine.html>

Stories about Robots

- ☆Challenge: Robbi's Robot

Robbi the Robot Story

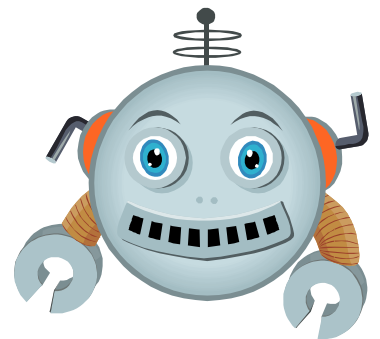
<http://www.pitara.com/talespin/stories/online.asp?story=72>

Games

- Train a Robot (be sure to read instructions!)

Robot Game

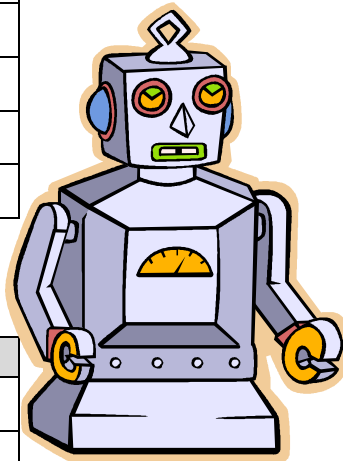
<http://members.learningplanet.com/act/runawayrobot/free.asp>



Robot Repair Exam - Day 1

Directions: Prove you have completed Robot Repair School Day 1. Complete each function table correctly.

Rule: $+ 3$	
<u>IN</u>	<u>OUT</u>
2	5
5	
7	
9	
12	



Rule: $- 4$	
<u>IN</u>	<u>OUT</u>
6	2
9	
10	
13	
4	

Rule: $+ 2$	
<u>IN</u>	<u>OUT</u>
7	9
9	
10	
5	
11	

Rule: $+ 5$	
<u>IN</u>	<u>OUT</u>
4	9
7	
11	
3	
15	

Rule: $- 3$	
<u>IN</u>	<u>OUT</u>
9	6
8	
4	
3	
10	



Rule: $+ 12$	
<u>IN</u>	<u>OUT</u>
2	
5	
8	
10	

Make your own input and output to fit the rule!

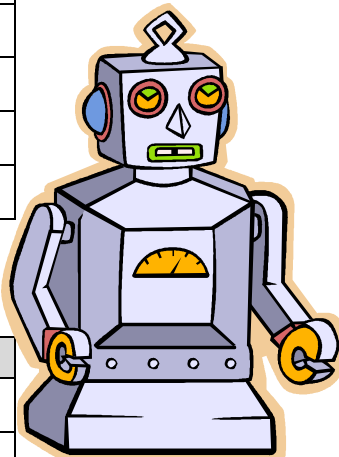
Name: _____ Date: _____

Robot Repair Exam - Day 1

Answer Key

Directions: Prove you have completed Robot Repair School Day 1. Complete each function table correctly.

Rule: $+ 3$	
<u>IN</u>	<u>OUT</u>
2	5
5	8
7	10
9	12
12	15



Rule: $- 4$	
<u>IN</u>	<u>OUT</u>
6	2
9	5
10	6
13	9
4	0

Rule: $+ 2$	
<u>IN</u>	<u>OUT</u>
7	9
9	11
10	12
5	7
11	13

Rule: $+ 5$	
<u>IN</u>	<u>OUT</u>
4	9
7	12
11	16
3	8
15	20

Rule: $- 3$	
<u>IN</u>	<u>OUT</u>
9	6
8	5
4	1
3	0
10	7



Rule: $+ 12$	
<u>IN</u>	<u>OUT</u>
2	14
5	17
8	20
10	22
answers	vary

Make your own input and output to fit the rule!

Name: _____ Date: _____

NUMBER CARDS to cut out

0

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20



ROBOT MISSING PARTS



MATERIALS

- paper bag with 24 manipulatives inside
- paper bowl

DIRECTIONS

- Partner 1 will take out any total of manipulatives up to 24 and will record the number of original manipulatives.
- Partner 2 closes his eyes while partner 1 hides some of the manipulatives under the bowl. Partner 2 opens his eyes and counts the part he sees and determines how many manipulatives must be hidden in the part under the bowl.
- Partner 1 then lifts the bowl and checks and records partner 2's answer. Partners switch roles and continue.

Part I Can See	+	Part hidden under the bowl	=	Number of original manipulatives
	+		=	
	+		=	
	+		=	
	+		=	
	+		=	
	+		=	
	+		=	
	.			

PARTNER 1: _____ PARTNER 2: _____

Rosie the Robot Function Tables

Rule: _____

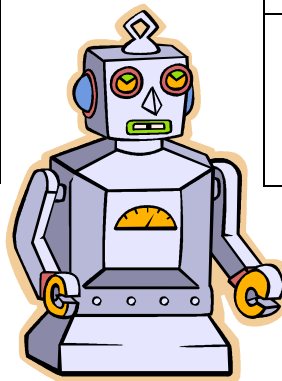
IN

OUT

Rule: _____

IN

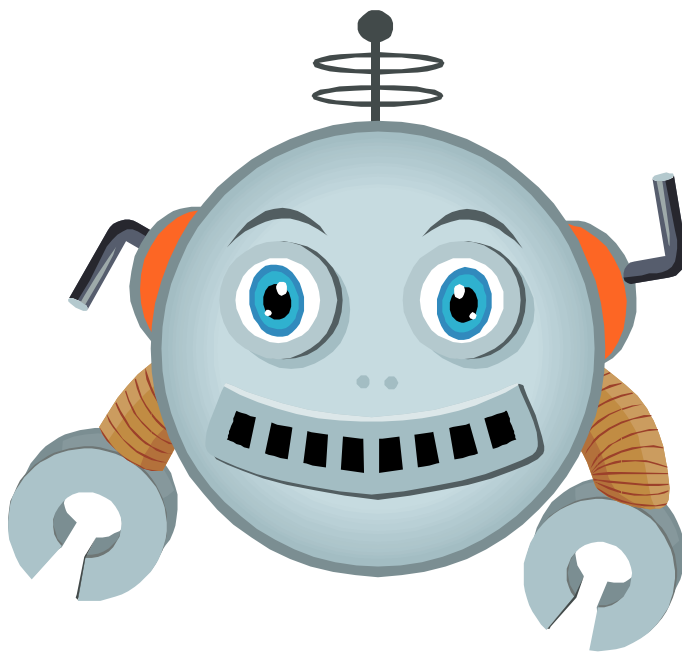
OUT



FILL IN ROBERT THE ROBOT'S FUNCTION TABLES

DIRECTIONS FOR THE TEACHER

- Divide students into groups of 3-4. Ahead of time, create empty function tables on the floor with masking tape. For each station, you will need an empty function table for each group of students as well as 2-3 extra.
- Distribute an envelope containing **Fill in Robert the Robot's Function Tables** for each group. Each group will use the cards to complete the function table. Students will place the cards into the empty spaces on the floor into the taped function table. Once the group has used the cards to fill in each space they will raise their hand to be checked by the teacher. Once they are correct, direct the group to put their cards back into the envelope and move to a different empty function table. They will leave the envelope with the empty function. The students rotate, not the envelopes.
- Monitor students as they complete empty function tables.



RULE: + 5

IN

OUT

5

10

11

16

2

7

3

8

0

5

1

6

RULE: + 4

IN

OUT

5

9

11

15

2

6

3

7

0

4

1

5

RULE: + 1

IN	OUT
5	6
11	12
2	3
3	4
0	1
1	2

RULE: + 0

IN	OUT
5	5
11	11
2	2
3	3
0	0
1	1

RULE: + 7

IN

OUT

3

10

9

16

0

7

1

8

4

11

5

12

RULE: + 9

IN

OUT

1

10

7

16

0

9

3

12

5

14

2

11

RULE: + 10

IN

OUT

0

10

6

16

7

17

13

23

5

15

16

26

RULE: - 5

IN

OUT

10

5

16

11

7

2

8

3

5

0

6

1

RULE: - 2

IN

OUT

10

8

16

14

7

5

8

6

5

3

6

4

RULE: - 4

IN

OUT

9

5

15

11

6

2

7

3

4

0

5

1

RULE: - 8

IN

OUT

10

2

16

8

8

0

18

10

9

1

15

7

RULE: - 6

IN

OUT

10

4

16

10

7

1

8

2

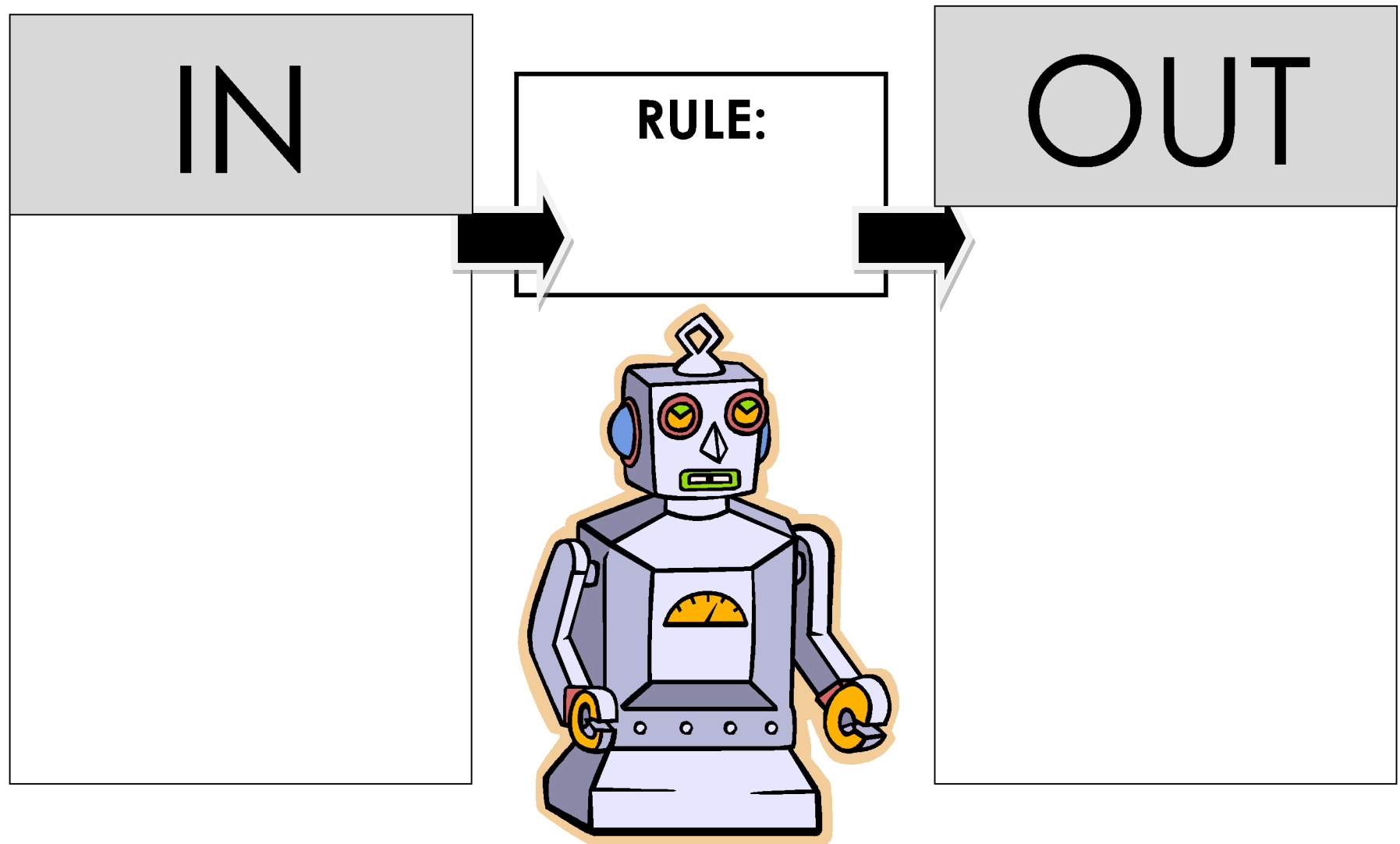
6

0

12

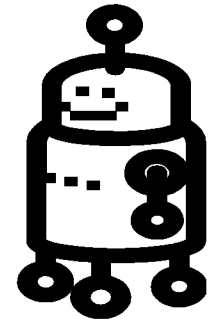
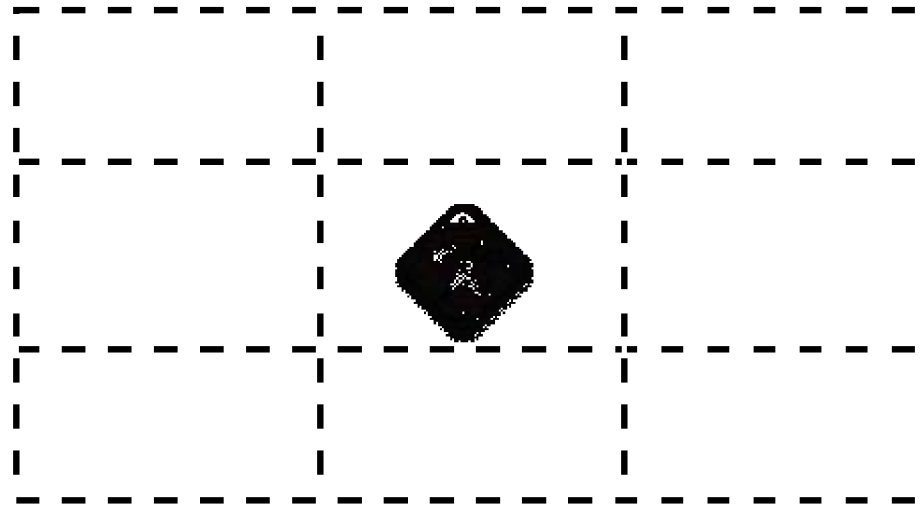
6

ROSIE the ROBOT: MANIPULATIVE MAT



Renee the Robot's Rectangle

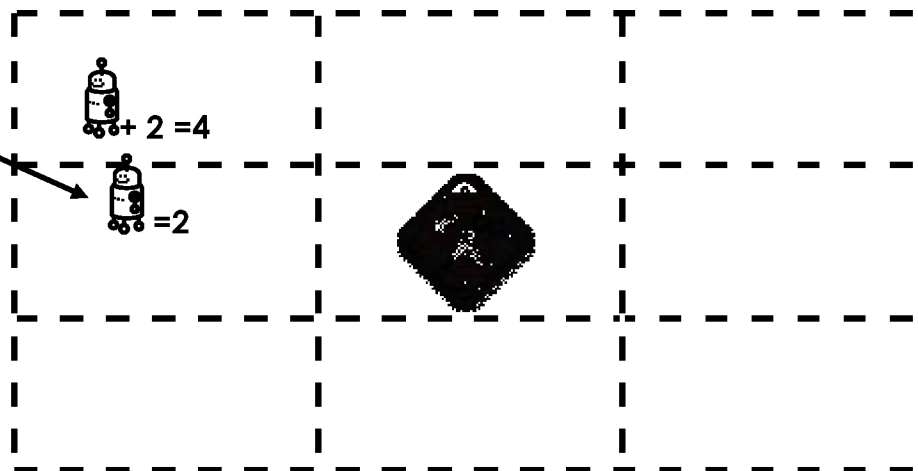
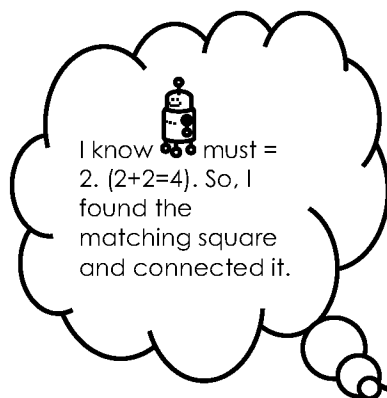
Teacher Directions

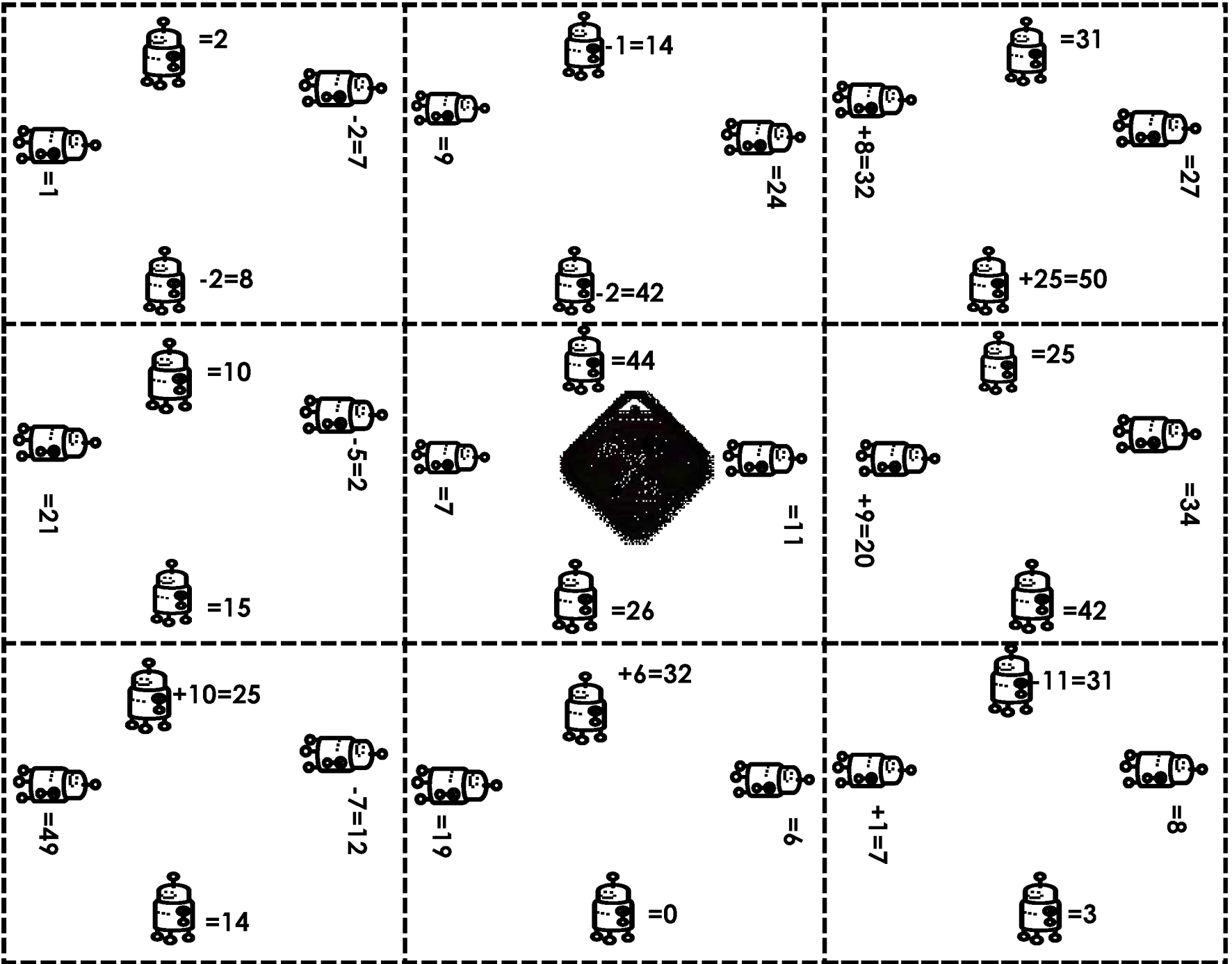


1. Prior to activity, print the attached page (be sure to print enough copies for your class).
2. Cut apart the rectangle along the dotted lines to create mini rectangles (9 total).
3. Place squares in an envelope. Paper clip the STUDENT DIRECTIONS with the envelope.
4. Set these envelopes in your Enrichment area for students to use on Day 2.

Renee the Robot's Rectangle Student Directions

1. Take the envelope back to your seat and pull out the mini rectangles within.
2. Your repair task:
 - a. Apply your understanding of the input-output relationship to the rule.
 - b. Determine the possible input (represented with a robot icon) for the square.
 - c. Once you found the answer to the input, find the square that has the answer.
 - d. Connect the two squares and continue to solve.
 - e. Your final result should be a completely connected rectangle.





Robotic-Web-Sites

At the same time, hold down the Control (Ctrl) key and click on the blue link.

Interactive Websites

- Interactive Robot Function Table Site

Input/Output Function Machine

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Find the Rule...X out a clone

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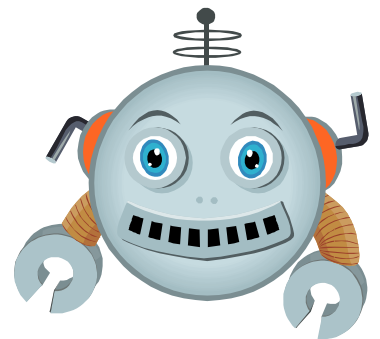
<http://www.pitara.com/talespin/stories/online.asp?story=72>

Games

- Train a Robot (be sure to read instructions!)

Robot Game

<http://members.learningplanet.com/act/runawayrobot/free.asp>



Robot Repair Exam - Day 2

Directions: Prove you have completed Robot Repair School Day 2. Complete each function table correctly.

Rule: $+ 4$	
<u>IN</u>	<u>OUT</u>
2	6
	5
	7
	10
	12

Rule: $- 3$	
<u>IN</u>	<u>OUT</u>
5	2
	4
	6
	5
	1



Rule: $+ 1$	
<u>IN</u>	<u>OUT</u>
2	3
	5
	6
	8
	2

Rule: $+ 6$	
<u>IN</u>	<u>OUT</u>
4	10
	7
	8
	9
	10

Rule: $- 5$	
<u>IN</u>	<u>OUT</u>
	1
	3
	8
	2
	6



Rule: $+ 11$	
<u>IN</u>	<u>OUT</u>
	20
	12
	15
	35

Make your own input and output to fit the rule!

Name: _____ Date: _____

Robot Repair Exam - Day 2

Answer Key

Directions: Prove you have completed Robot Repair School Day 2. Complete each function table correctly.

Rule: $+ 4$	
<u>IN</u>	<u>OUT</u>
2	6
1	5
3	7
6	10
8	12

Rule: $- 3$	
<u>IN</u>	<u>OUT</u>
5	2
7	4
9	6
8	5
4	1



Rule: $+ 1$	
<u>IN</u>	<u>OUT</u>
2	3
4	5
5	6
7	8
1	2

Rule: $+ 6$	
<u>IN</u>	<u>OUT</u>
4	10
1	7
2	8
3	9
5	11

Rule: $- 5$	
<u>IN</u>	<u>OUT</u>
6	1
8	3
13	8
7	2
11	6



Rule: $+ 11$	
<u>IN</u>	<u>OUT</u>
9	20
3	12
4	15
24	35

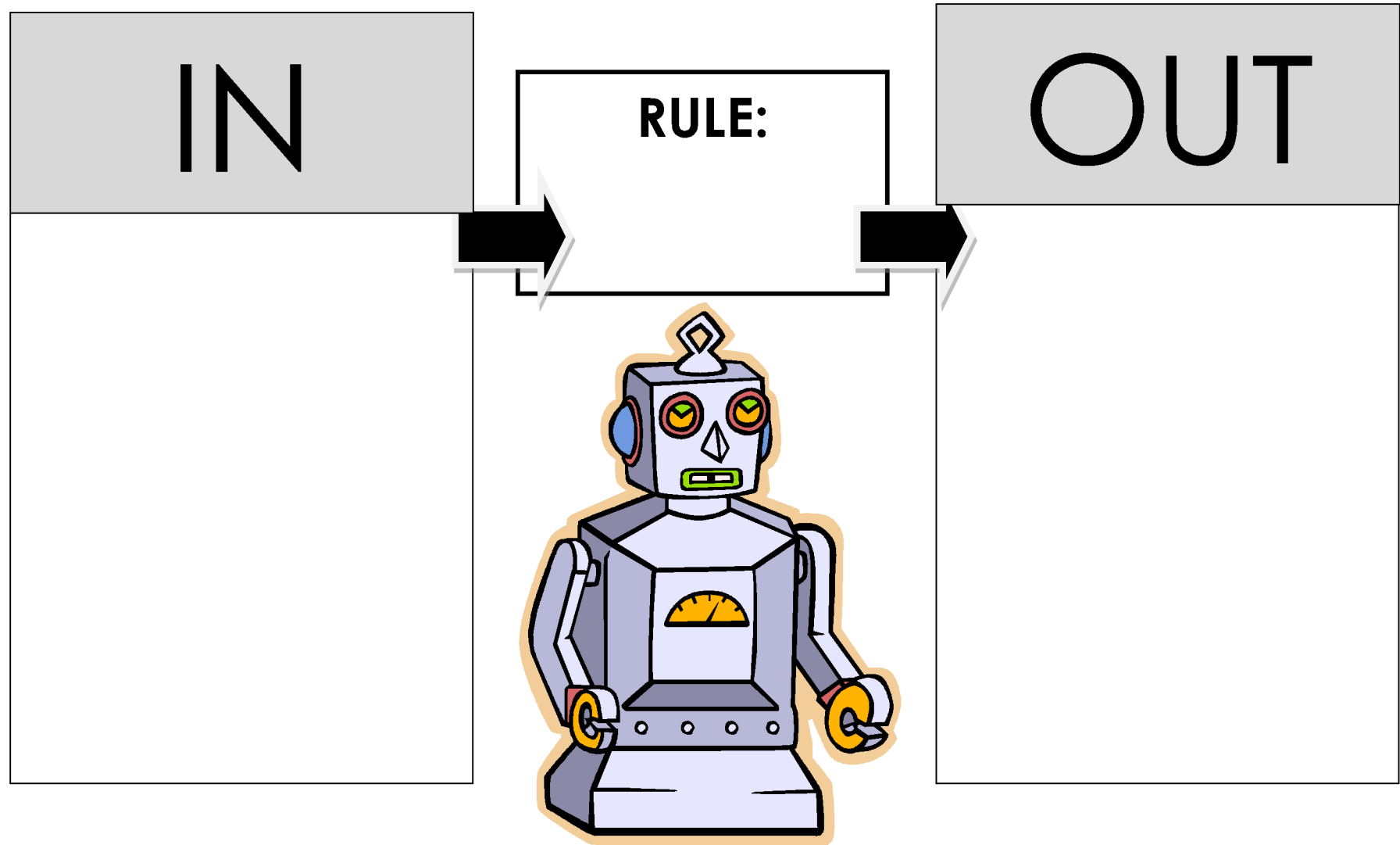
Make your own input and output to fit the rule!

Name: _____ Date: _____

Explore: Equations Sorting Activity

$2 \bigcirc 5 = 7$	$3 \bigcirc 1 = 4$	$8 \bigcirc 2 = 10$
$9 \bigcirc 3 = 6$	$8 \bigcirc 4 = 4$	$10 \bigcirc 6 = 4$
$1 \bigcirc 6 = 7$	$2 \bigcirc 1 = 3$	$4 \bigcirc 9 = 13$
$7 \bigcirc 5 = 2$	$5 \bigcirc 5 = 0$	$6 \bigcirc 3 = 3$

ROSIE the ROBOT: MANIPULATIVE MAT



Rosie the Robot Function Tables

Rule: _____

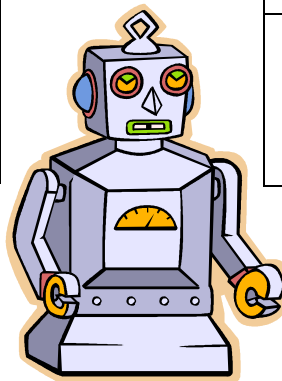
IN

OUT

Rule: _____

IN

OUT



Robot Mind Match

p. 1

Rule: <u>?</u>	
<u>IN</u>	<u>OUT</u>
2	10
4	12
6	14
8	16

Rule: <u>?</u>	
<u>IN</u>	<u>OUT</u>
5	8
7	10
11	14
16	19

Rule: <u>?</u>	
<u>IN</u>	<u>OUT</u>
3	10
5	12
7	14
9	16

Rule: <u>?</u>	
<u>IN</u>	<u>OUT</u>
3	8
6	11
10	15
12	17

Rule: <u>?</u>	
<u>IN</u>	<u>OUT</u>
4	8
12	16
14	18
15	19

Rule: <u>?</u>	
<u>IN</u>	<u>OUT</u>
11	12
12	13
13	14
14	15

Robot Mind Match

p. 2

<table><tr><th colspan="2">Rule: __?</th></tr><tr><th><u>IN</u></th><th><u>OUT</u></th></tr><tr><td>13</td><td>12</td></tr><tr><td>11</td><td>10</td></tr><tr><td>9</td><td>8</td></tr><tr><td>5</td><td>4</td></tr></table>	Rule: __?		<u>IN</u>	<u>OUT</u>	13	12	11	10	9	8	5	4	<table><tr><th colspan="2">Rule: __?</th></tr><tr><th><u>IN</u></th><th><u>OUT</u></th></tr><tr><td>12</td><td>9</td></tr><tr><td>9</td><td>6</td></tr><tr><td>4</td><td>1</td></tr><tr><td>3</td><td>0</td></tr></table>	Rule: __?		<u>IN</u>	<u>OUT</u>	12	9	9	6	4	1	3	0	<table><tr><th colspan="2">Rule: __?</th></tr><tr><th><u>IN</u></th><th><u>OUT</u></th></tr><tr><td>6</td><td>1</td></tr><tr><td>8</td><td>3</td></tr><tr><td>10</td><td>5</td></tr><tr><td>13</td><td>8</td></tr></table>	Rule: __?		<u>IN</u>	<u>OUT</u>	6	1	8	3	10	5	13	8
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<u>IN</u>	<u>OUT</u>																																					
13	12																																					
11	10																																					
9	8																																					
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Rule: __?																																						
<u>IN</u>	<u>OUT</u>																																					
12	9																																					
9	6																																					
4	1																																					
3	0																																					
Rule: __?																																						
<u>IN</u>	<u>OUT</u>																																					
6	1																																					
8	3																																					
10	5																																					
13	8																																					
<table><tr><th colspan="2">Rule: __?</th></tr><tr><th><u>IN</u></th><th><u>OUT</u></th></tr><tr><td>2</td><td>0</td></tr><tr><td>4</td><td>2</td></tr><tr><td>6</td><td>4</td></tr><tr><td>8</td><td>6</td></tr></table>	Rule: __?		<u>IN</u>	<u>OUT</u>	2	0	4	2	6	4	8	6	<table><tr><th colspan="2">Rule: __?</th></tr><tr><th><u>IN</u></th><th><u>OUT</u></th></tr><tr><td>10</td><td>4</td></tr><tr><td>12</td><td>6</td></tr><tr><td>13</td><td>7</td></tr><tr><td>15</td><td>9</td></tr></table>	Rule: __?		<u>IN</u>	<u>OUT</u>	10	4	12	6	13	7	15	9	<table><tr><th colspan="2">Rule: __?</th></tr><tr><th><u>IN</u></th><th><u>OUT</u></th></tr><tr><td>9</td><td>5</td></tr><tr><td>12</td><td>8</td></tr><tr><td>15</td><td>11</td></tr><tr><td>17</td><td>13</td></tr></table>	Rule: __?		<u>IN</u>	<u>OUT</u>	9	5	12	8	15	11	17	13
Rule: __?																																						
<u>IN</u>	<u>OUT</u>																																					
2	0																																					
4	2																																					
6	4																																					
8	6																																					
Rule: __?																																						
<u>IN</u>	<u>OUT</u>																																					
10	4																																					
12	6																																					
13	7																																					
15	9																																					
Rule: __?																																						
<u>IN</u>	<u>OUT</u>																																					
9	5																																					
12	8																																					
15	11																																					
17	13																																					

Robot Mind Match

p. 3

Rule: + 8

Rule: + 3

Rule: + 7

Rule: + 5

Rule: + 4

Rule: + 1

Robot Mind Match

p. 4

Rule: - 1 Rule: - 3 Rule: - 5

Rule: - 2 Rule: - 6 Rule: - 4

Robotic-Web-Sites

At the same time, hold down the Control (Ctrl) key and click on the blue link.

Interactive Websites

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Input/Output Function Machine

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Find the RULE and SOLVE

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- Stop That Creature!

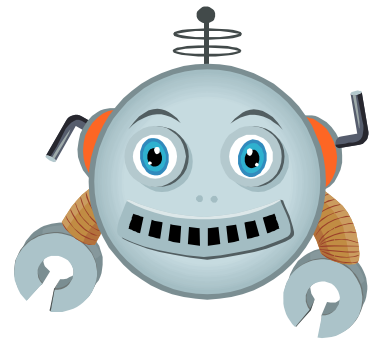
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Games

- Train a Robot (be sure to read instructions!)

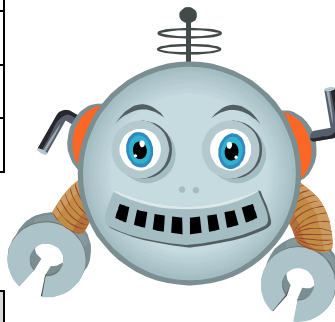
Robot Game

<http://members.learningplanet.com/act/runawayrobot/free.asp>

Robot Repair Exam - Day 3

Directions: Prove you have completed Robot Repair School Day 3. Complete each function table correctly. Don't forget to write the missing rule or information.

Rule: _____	
<u>IN</u>	<u>OUT</u>
4	5
7	8
9	10
11	12
3	4



Rule: _____	
<u>IN</u>	<u>OUT</u>
5	9
7	11
8	12
10	14
6	10

Rule: _____	
<u>IN</u>	<u>OUT</u>
5	10
7	12
8	13
10	15
6	11

Rule: + 6	
<u>IN</u>	<u>OUT</u>
2	
	9
5	
	10
11	

Rule: - 7	
<u>IN</u>	<u>OUT</u>
10	
	2
12	
	1
7	



Make your own rule, input and output!

Rule: _____	
<u>IN</u>	<u>OUT</u>

Name: _____ Date: _____

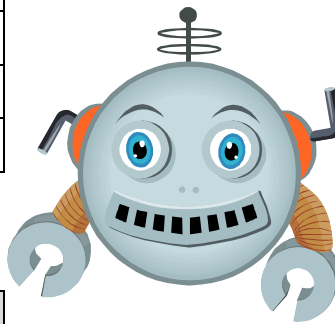
Robot Repair Exam - Day 3

Answer Key

Directions: Prove you have completed Robot Repair School Day 3. Complete each function table correctly. Don't forget to write the missing rule or information.

Rule: <u>+ 1</u>	
<u>IN</u>	<u>OUT</u>
4	5
7	8
9	10
11	12
3	4

Rule: <u>+ 4</u>	
<u>IN</u>	<u>OUT</u>
5	9
7	11
8	12
10	14
6	10



Rule: <u>+ 5</u>	
<u>IN</u>	<u>OUT</u>
5	10
7	12
8	13
10	15
6	11

Rule: <u>+ 6</u>	
<u>IN</u>	<u>OUT</u>
2	8
3	9
5	11
4	10
11	17

Rule: <u>- 7</u>	
<u>IN</u>	<u>OUT</u>
10	3
9	2
12	5
8	1
7	0



Make your own rule, input and output!

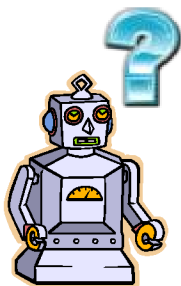
Rule: _____	
<u>IN</u>	<u>OUT</u>

Answers will vary.

Name: _____ Date: _____

Robot Repair School Certification Test

Name: _____ Date: _____



Help Rosie find the outputs and inputs.

1.

Rule: <u>+ 4</u>	
<u>IN</u>	<u>OUT</u>
1	5
10	
12	
14	

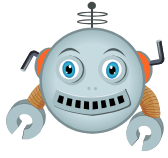
2.

Rule: <u>- 3</u>	
<u>IN</u>	<u>OUT</u>
8	5
	6
	9
	11

What is the rule of this table?

3.

Rule: <u> </u>	
<u>IN</u>	<u>OUT</u>
3	8
11	16
13	18
15	20



Something is wrong with Robert! He is missing some of his numbers!
Help Robert finish his tables.

4.

Rule: <u>+ 6</u>	
<u>IN</u>	<u>OUT</u>
2	
	10
11	
	18

5.

Rule: <u>- 2</u>	
<u>IN</u>	<u>OUT</u>
	7
6	
	15
15	

6.

Rule: <u>+ 4</u>	
<u>IN</u>	<u>OUT</u>
4	
	12
10	
	15

7. Renee the robot has come to you for a checkup. The rule of her function table is “+2”. Look at her table below.



Rule: <u>+ 2</u>	
<u>IN</u>	<u>OUT</u>
1	3
5	7
8	10
12	13

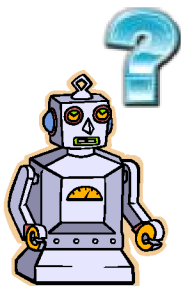
Is Renee's table correct? Yes or No? _____

Why or why not? Explain your thinking.

Robot Repair School Certification Test

Answer Key

Name: _____ Date: _____



Help Rosie find the outputs and inputs.

1.

Rule: <u>+ 4</u>	
<u>IN</u>	<u>OUT</u>
1	5
10	14
12	16
14	18

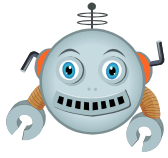
2.

Rule: <u>- 3</u>	
<u>IN</u>	<u>OUT</u>
8	5
9	6
12	9
14	11

What is the rule of this table?

3.

Rule: <u>+ 5</u>	
<u>IN</u>	<u>OUT</u>
3	8
11	16
13	18
15	20



Something is wrong with Robert! He is missing some of his numbers!
Help Robert finish his tables.

4.

Rule: <u> </u> + <u> </u> 6	
<u>IN</u>	<u>OUT</u>
2	8
4	10
11	17
12	18

5.

Rule: <u> </u> - <u> </u> 2	
<u>IN</u>	<u>OUT</u>
9	7
6	4
17	15
15	13

6.

Rule: <u> </u> + <u> </u> 4	
<u>IN</u>	<u>OUT</u>
4	8
8	12
10	14
11	15

7. Renee the robot has come to you for a checkup. The rule of her function table is "+2". Look at her table below.



Rule: <u>+ 2</u>	
<u>IN</u>	<u>OUT</u>
1	3
5	7
8	10
12	13

Is Renee's table correct? Yes or No? No

Why or why not? Explain your thinking.

Renee's table is not correct because the bottom row is wrong. The rule is + 2 so that means you need to add 2 to every input number. Renee's bottom row says that if you add 2 to 12 you will get 13, but $12 + 2 = 14$. You would have to add 1 to 12 to get 13 and that is not the rule.

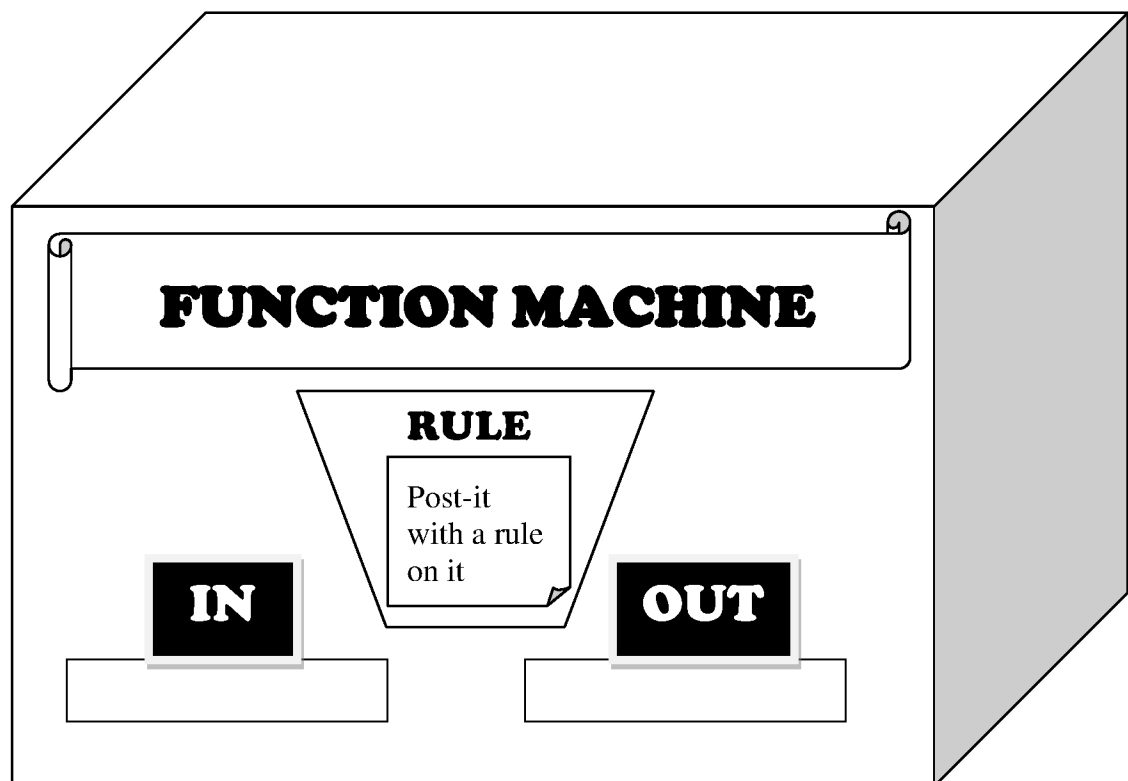
FUNCTION MACHINE DIRECTIONS

Function Machine Creation

1. Find an empty shoe or copy box. On the bottom of the box, cut 2 slits and assemble as shown. Cut out and use the labels below or create your own.
2. Decorate your box to your own theme. Use wrapping paper, foil, yarn, stickers, etc.

Function Machine Usage

3. Write a rule on a post-it and place on the Rule panel.
4. Place box so that the bottom side of box is facing students and the open part is hidden from student view. Inside the box, you will need to have a marker.
5. Use index cards or the included number cards and insert a card into the IN slit.
6. Once the card is inside the box out of student view, teacher applies the rule and writes the correct answer on the back and slides it out of the OUT slot.

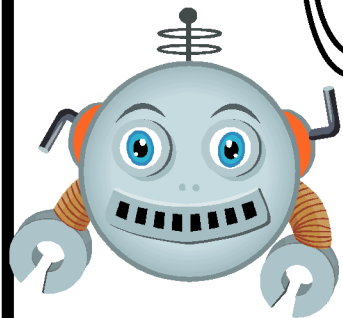


FUNCTION MACHINE

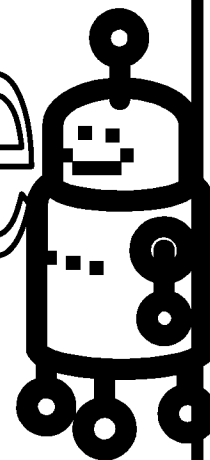
RULE

IN

OUT



Graduation Certificate



This is to certify _____ is a
certified Robot Repairperson!

**You have successfully completed Robot Repair
School and can tackle Flawed Functions that
are in need of repair!**

Signed,

Rosie, Robbie, and Renee the Robots

Witnessed by your teacher: _____

